

Field observations of the nocturnal mantle-flap lure of *Lampsilis teres*

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Abstract: Three yellow sandshell mussels, *Lampsilis teres* (Rafinesque, 1820), were observed in Lake Tuscaloosa, Alabama, and the temporal display pattern of their mantle-flap lures was investigated *in situ*. All three gravid females fully displayed their mantle-flap lures after dark during each nighttime visit ($N = 3$) but none displayed their lures during daytime ($N = 3$). An encounter between a mantle-lure and a largemouth bass was observed. These observations are the first reported of *in situ* mantle-flap lure displays and fish host encounters for *L. teres*, and support previous studies of diel display patterns in other mantle-lure displaying mussels. This diel lure display may be related to the ecology of the fish hosts they seek to attract. Future daytime and, especially, nighttime field observations of bivalve mussels with mantle-flap lures may greatly improve understanding of their reproductive ecology.

Key words: Bivalvia, diel, mussel, unionid, largemouth bass

Gravid, mature females of the mussel genus *Lampsilis* Rafinesque, 1820 display elaborate mantle-flap lures to attract fish hosts for glochidial larvae (Ortmann 1914, Kraemer 1970, Haag *et al.* 1999). Mantle-flap lure displays vary in response to time of day, light conditions, and presence of suitable fish hosts, and there appear to be interspecific differences in when displays begin (Kraemer 1970, Haag and Warren 2000). These variations may be related to the diel habits of the fish hosts used by each mussel species (Welsh 1933).

Lampsilis teres Rafinesque, 1820 is a unionid bivalve with a wide distribution from Mexico north to Minnesota and is found in the Mississippi, Rio Grande, Mobile, and Gulf drainages (Parmalee and Bogan 1998). The species is especially common in the southeastern U.S.A., prefers pool and shallow sandbar habitats (Ortmann 1926, Parmalee and Bogan 1998), and is often abundant in river impoundments (C. Lydeard, Smithsonian Institution, pers. comm.). Known fish hosts of *L. teres* include alligator gar (*Atractosteus spatula*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), longnose gar (*Lepisosteus osseus*), orangespotted sunfish (*Lepomis humilis*), shortnose gar (*Lepisosteus platostomus*), shovelnose sturgeon (*Scaphirhynchus platyrhynchus*), and warmouth (*Lepomis gulosus*) (Watters 1994).

Previous studies (Kraemer 1970, Trdan 1981, Haag and Warren 1999, Haag and Warren 2000) have documented the reproductive strategy of displaying mussels and showed, under laboratory conditions, that mantle-lure displays respond to presence of fish hosts, light conditions, and substrate disturbance. However, no studies have reported *in situ* field observations of mantle-flap lure displays, and I briefly de-

scribe field observations of the mantle-flap lure of *Lampsilis teres*, including morphology, display timing, and physical encounters with fish.

MATERIALS AND METHODS

In May 2005 in Lake Tuscaloosa (an impoundment of the North River, Mobile River basin), Tuscaloosa County, Alabama, three individuals of *Lampsilis teres* (yellow sandshell) were observed displaying mantle-lures after dark beneath a boat dock (depth *ca.* 1.4-2.0 m). Using a flashlight, I observed each specimen from the dock, presumably without affecting the display pattern of their mantle-lures. Subsequent visits to this site were made over the next three days (11-13 May 2005, 12:00-4:00 PM) and three nights (11-14 May 2005, 9:00 PM-1:00 AM) to observe diel display behavior. Observations on the timing, morphological characteristics of the lure, and any interactions with fish were noted.

RESULTS

Display timing

All three specimens were in full display during each nocturnal visit, and no lures were displayed during daylight visits. The mussels were buried in the sediment at a slight angle (posterior facing up) with their mantle-flap lures fully extended and pulsating. During one visit just prior to dusk, none of the mussels were displaying; however, as the sun set, one specimen began to display. After sunset, the other two mussels began displaying their lures. During this twilight period, one mussel slowly moved from a horizontal position

adjacent to a rock to soft sediment where it positioned itself vertically and began to display. The displays were periodic and occurred in episodes of various lengths. Total palpitations per episode of all 3 mussels ranged from 4 to 26 before individuals rested. Palpitating episodes lasted for 6 to 177 s and rest periods ranged in time from 10 to 98 s before recommencement.

Lure morphology

Mantle-lures were approx. 3-4 cm maximum length and 2 cm in maximum width (Fig. 1). The tissue was a dark pink color in the interior and white and tan on the margins. When fully displayed, the margins were wavy in appearance and resembled small fishes. The lures varied slightly in morphology and color depending on the individual, but the margin of all lures undulated during displays, while the interior of the lures pulsed. As the display was initiated, the lure would extend slowly from the mantle, motionless at

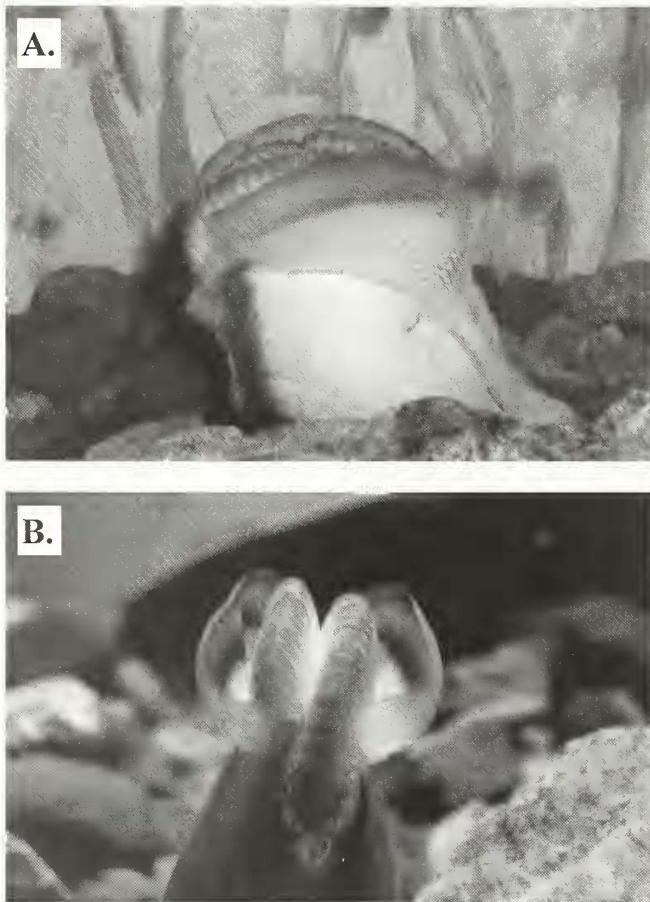


Figure 1. A, Lateral and B, anterior view of the mantle-flap lure of *Lampsilis teres*. Photographs (© 2008 by Paul Frese) reproduced with the permission of the copyright holder.

first, and slowly begin to palpitate. When only moderately or minimally displayed, the lure appeared to have less motion and color.

Fish encounters

Fish were observed within the immediate vicinity of the mussels frequently. The fishes included bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), and largemouth bass (*Micropterus salmoides*). Relatively large numbers of small longear and bluegill sunfish were seen during both day and night visits, but a largemouth bass ($N = 1$, ~115 cm total length) was encountered only once, at night. The bass approached a mantle-lure in full display and struck it. Following the strike, the bass retreated for 2-5 s and swam off. The mussel continued to display immediately following the strike and rested only after the bass had left. Although small bluegill and longear sunfish were present during all visits, there were no attacks by these fish on the displaying lures although these fish would often pay close attention to a lure in full display.

DISCUSSION

Display timing

The observation that *Lampsilis teres* displays occurred only at night indicates that daytime is not an effective time to attract a suitable fish host. These observations provide further documentation that lure displays vary with time of day and presence of suitable fish hosts (Haag and Warren 2000). Many centrarchids and a number of other freshwater fishes are known to exhibit diel movements and generally move from more midstream or open-water during the day to littoral habitats at night (Helfman 1993, Shoup *et al.* 2004, Rypel and Mitchell 2007). These movements are coupled with the movements of their prey, many of which are also driven by diel cycle (Helfman 1993, Layman and Winemiller 2004). Sunfishes were observed in numbers around the displaying mussels at night and are known to be important prey for adult largemouth bass (Cochran and Adelman 1982, Howick and O'Brien 1983, Gabelhouse 1987). By displaying lures during times which maximize fish host encounters, mussels would improve glochidial transmission. The temporal differences in lure display for *L. teres* at this site were presumably a product of diel changes in host fish locations.

Lure morphology

Mussel species that use large predacious fishes as hosts generally display modified mantle-lures which strongly resemble small prey fishes, insects, and aquatic insect larvae (Kraemer 1970, Haag and Warren 2000). Considering the number of small centrarchid fishes consistently present near

the mussels and the lure's color and shape, this mantle-lure apparently mimics these small sunfishes. Each mussel's shell color matched the substrate such that the shells are cryptic in sand and gravel. Meanwhile, the mantle-lure was pink, which combined with the palpitating motions, accentuated the lure's motion underwater, apparently to attract fishes.

Fish encounters

A largemouth bass biting the *Lampsilis teres* mantle-lure demonstrates that the lure is effective at attracting a suitable fish host (Fuller 1974, Watters 1994). In other trips to this site, I have also collected black crappie and warmouth, both of which are reported as fish hosts for this mussel (Watters 1994). Channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), freshwater drum (*Aplodinotus grunniens*), smallmouth buffalo (*Ictiobus bubalus*), spotted bass (*Micropterus punctulatus*), and spotted gar (*Lepisosteus oculatus*) were also collected, although they are currently not believed to be hosts for *L. teres*. Fitness of *L. teres*, and possibly other nighttime mantle-lure displaying mussels, could be tied to diel movements of fishes. Bluegill and longear sunfish, the other fishes consistently observed near the vicinity of the lures, have not yet been identified as fish hosts for *L. teres* (Watters 1994, Parmalee and Bogan 1998). However, the fact that they are not listed as hosts does not preclude their potential as a host under certain environmental conditions. If one species of *Lepomis* were a host, another species within the genus can, at times, also serve as a host (Haag and Warren 2003). These observations corroborate previous reports of freshwater unionids utilizing nighttime displays to attract fish hosts (Haag and Warren 2000, Toomey et al. 2002) and suggest that nighttime observations may provide information on display behavior in mussel species that have not been encountered displaying during daytime.

Additional field observations on the diel nature of other freshwater mussel species are necessary. If night were a critical display period for other unionids, then such observations would be critical to future conservation efforts such as captive breeding programs. Field observations might reveal primary hosts, especially if the host fishes are nocturnal, cryptic, or rare, and could generate new data and questions regarding the ecology of mantle-flap lures. Fish host identification is often based on a "shotgun approach" involving laboratory infestation tests on a variety of sympatric and common fishes suspected to be hosts. However, lists of potential fish hosts may be inadequate, especially if we ignore fish-mussel encounters occurring at night. The ecology of nocturnal freshwater fishes is not understood well and the diel movements of even well-studied fishes have gone somewhat underappreciated until only recently (Shoup et al. 2004, Rypel and Mitchell 2007). Future research on the diel ecology of

freshwater mussels will be similarly necessary to develop a more robust understanding of unionids.

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LITERATURE CITED

- Cochran, P. A. and I. R. Adelman. 1982. Seasonal aspects of daily ration and diet of largemouth bass, *Micropterus salmoides*, with an evaluation of gastric evacuation rates. *Environmental Biology of Fishes* 7: 265-275.
- Fuller, S. L. H. 1974. Clams and mussels (Mollusca: Bivalvia). In: C. W. Hart, Jr. and S. L. H. Fuller, eds., *Pollution Ecology of Freshwater Invertebrates*. Academic Press, New York, New York. Pp. 215-273.
- Gabelhouse, D. W. 1987. Responses of largemouth bass and bluegill to removal of surplus largemouth bass from a Kansas pond. *North American Journal of Fisheries Management* 7: 81-90.
- Haag, W. R. and M. L. Warren, Jr. 1999. Mantle displays of freshwater mussels elicit attacks from fish. *Freshwater Biology* 42: 35-40.
- Haag, W. R., M. L. Warren, Jr., and M. Shillingsford. 1999. Host fishes and host-attracting behavior of *Lampsilis altilis* and *Villosa vibex* (Bivalvia: Unionidae). *American Midland Naturalist* 141: 149-157.
- Haag, W. R. and M. L. Warren, Jr. 2000. Effects of light and presence of fish on lure display and larval release behaviours in two species of freshwater mussels. *Animal Behaviour* 60: 879-886.
- Haag, W. R. and M. L. Warren, Jr. 2003. Host fishes and infection strategies of freshwater mussels in large Mobile Basin streams, USA. *Journal of the North American Benthological Society* 22: 78-91.
- Helfman, G. S. 1993. Fish behavior by day, night and twilight. In: T. J. Pitcher, ed., *Behavior of Teleost Fishes*. Vol. 7. Chapman and Hall, London. Pp. 479-512.
- Howick, G. L. and W. J. O'Brien. 1983. Piscivorous feeding behavior of largemouth bass: An experimental study. *Transactions of the American Fisheries Society* 112: 508-516.
- Kraemer, L. R. 1970. The mantle flap in three species of *Lampsilis* (Pelecypoda: Unionidae). *Malacologia* 10: 225-282.
- Layman, C. A. and K. O. Winemiller. 2004. Size-based responses of prey to piscivore exclusion in a species-rich neotropical river. *Ecology* 85: 1311-1320.

- Ortmann, A. E. 1914. Studies in najades (cont.). *The Nautilus* **28**: 41-47.
- Ortmann, A. E. 1926. Unionidae from the Reelfoot Lake region in West Tennessee. *The Nautilus* **39**: 87-94.
- Parmalee, P. W. and A. E. Bogan. 1998. *The Freshwater Mussels of Tennessee*. University of Tennessee Press, Knoxville, Tennessee.
- Rypel, A. L. and J. B. Mitchell. 2007. Summer nocturnal patterns in freshwater drum. *American Midland Naturalist* **157**: 230-234.
- Shoup, D. E., R. E. Carlson, and R. T. Heath. 2004. Diel activity levels of centrarchid fishes in a small Ohio lake. *Transactions of the American Fisheries Society* **5**: 1264-1269.
- Toomey, M. B., D. McCabe, and J. E. Marsden. 2002. Factors affecting the movement of adult zebra mussels (*Dreissena polymorpha*). *Journal of the North American Benthological Society* **21**: 468-475.
- Trdan, R. J. 1981. Reproductive biology of *Lampsilis radiata siliquoidea* (Pelecypoda: Unionidae). *American Midland Naturalist* **106**: 243-248.
- Watters, G. T. 1994. *An annotated bibliography of the reproduction and propagation of the Unionoidea (Primarily of North America)*. Ohio Biological Survey, Ohio State University, Columbus, Ohio.
- Welsh, J. H. 1933. Photic stimulations and rhythmical contractions of the mantle flaps of a lamellibranch. *Proceedings of the National Academy of Science* **19**: 755-757.

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